Contribution of Childhood Intakes to Population Risks from Inhaled and Ingested Radionuclides

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The U.S. Environmental Protection Agency (U.S. EPA) uses state-of-the-art methods and models to assess human health risks from internal and external exposure to radionuclides. These risk estimates account for age and gender dependence of intake, radionuclide metabolism, radiation dosimetry, radiogenic risks, and competing causes of death. Federal Guidance Report No. 13 (U.S. EPA 402-R-99-01) contains the Agency's current cancer risk coefficients for over 800 radionuclides: i.e., estimates of the probability of radiogenic cancer mortality or morbidity per unit activity inhaled or ingested, for internal exposure, or per unit time-integrated activity for external exposure. When combined with estimates of radionuclide intakes or exposures, the cancer risk coefficients are used to determine age-averaged, lifetime excess cancer risks in exposed populations.

In the present study, the U.S. EPA collaborated with the Oak Ridge National Laboratory (ORNL) in using the DCAL (Dose and Risk Calculation) software developed at ORNL to calculate age-dependent cancer risk estimates for selected radionuclides. Specifically, this collaboration resulted in a determination of the contribution to the lifetime cancer risk from intakes of radionuclides for various age intervals, taking into account age variations in intake rates, dosimetry, and risks per unit dose. Although childhood intakes are, on average, generally lower than for adults, risks per unit dose and radiation doses per unit intake are often higher for children. As a result, for most radionuclides of interest, it is found that childhood exposures contribute disproportionately to the general population risk.

These results highlight the importance of children as a sensitive subpopulation. Moreover, these results indicate that a substantial fraction of the lifetime risk from a chronic exposure is incurred during childhood.